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ABSTRACT

A suggested approach, termed value analysis, to studying the cost effectiveness of alternative plans for vocational-technical facilities presents a series of cost diagrams and decision matrices, with explication. The diagrammed steps are: (1) Value-Analysis Cost Schedule, representing a hypothetical facility being planned and showing estimated costs for the desired accommodation; (2) Cost/Achievement Relationship of Various Alternatives, presenting a method of ranking cost data for facility and program operation costs and relating reliable job placements to costs of various alternative programs; (3) Decision Matrix for Three Alternatives, illustrating decision making between several options within a program area; (4) Established Relationship Between Cost and Appraisal Score (Normalization Procedure), converting costs into normalized appraisal scores to determine relative values of the various options; (5) Decision Matrix for Four Vocational/Technical Programs Competing for Space in New Construction, illustrating the use of the decision-matrix approach for making decisions between program areas; and (6) High to Low Relative Value Options with Costs, identifying where deletions must be made. It is suggested that value analysis planning techniques are tools for better decision making. In particular value analysis provides documentation to substantiate major planning decisions. (LH)

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INNOVATIVE PLANNING TECHNIQUES FOR VOCATIONAL-TECHNICAL FACILITIES

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Most of the decisions any of us make are based upon what can be termed presumptive knowledge. We <u>presume</u> that we have analyzed all relevant factors. This is an acceptable situation as long as our decisions are relatively inconsequential, affecting ourselves alone or our immediate family and friends or do not involve large sums of money or have major impact upon the lives of others. But what of those decisions which carry the seeds of future committment? There are plenty of these in vocational and technical education: decisions to create and fund new instructional programs, decisions to reduce or delete existing programs, decisions to plan and build the physical facilities needed for these vocational-technical programs. How can we make these planning decisions on a more rational basis? A body of analytical techniques are available which can improve anyone's decision-making process. Generally termed "value analysis" from its origins in American industry as a methodology for studying cost effectiveness of alternative manufacturing methods, the procedures are relatively simple, easily implemented by anyone of reasonable intelligence, and applicable to any decisional setting.

A fundamental starting point for good decisions is cost. Figure 1 represents a value-analysis schedule for a hypothetical vocational facility being planned. As you can see from this schedule, a series of program

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spaces are defined by area (column 4), by planned capacity at any one time (column 5 - "Units of Use"), by the number of students processed over a given period of time (column 6 - "Output Units"), by "Base Cost" (which is the cost of the rough construction of the space), by the "Ancillary Space Cost" (which is the cost of a pro-rata share of building service spaces such as corridors, mechanical rooms, toilet rooms, etc., attributable to the area shown in column 4), the "Added Cost" of the space (which is the cost of finishes, loose and fixed equipment, and everything else needed to make the space usable for instruction), and "Total Cost" (which is the sum of columns 7-9). This schedule is summarized in the Figure 1 example but in actuality will run to many pages of detailed cost data. This schedule should be prepared prior to the development of schematic architectural plans and should include any and all programs which are under consideration for inclusion in a new facility.

The total estimated cost may well exceed what you know are the available funds but resist the temptation to get too cost-conscious at this stage of value analysis. How do you acquire these cost estimates? Obviously, this procedure requires extremely detailed and accurate costing. If your architect is already under contract and has a competent value engineering department, he can provide this information based upon your imput. Or you can engage one of the following to provide this data: an architectural firm (on a time-and-materials basis) which has a good value-analysis capability, a professional estimating firm, or a reputable large contractor (again on a time-and-materials basis) who has a value-engineering staff.

The last two columns in Figure 1 provide the "Cost per Unit of Use" and the "Cost per Output Unit" (i.e., cost divided by number of students processed or graduated in a given period of time). These columns give relative rather than absolute costs, permitting cross-comparison of program costs.

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Cost per output unit (or program graduate) does not tell the whole story. We should really relate that cost in some manner to actual or estimated job placement rates. Figure 2 indicates one method of ranking cost data for facility and program operation costs. A number of alternative spaces and programs are compared using the percent of reliable job placement (column 'a'), the capital cost of the facilities (column 'b') as derived from the detailed cost analysis in Figure 1, the estimated (or actual) program operation cost of the alternative (column 'c'), and the cost per percent of reliable job placement if alternative approaches to the same occupational goal are being listed (and assuming that the number of students in each alternative program are identical) or the cost per job placement if non-alternates are being considered. A "Worth Ceiling" is useful as an additional column, supplying an upper limit beyond which higher costs will not be accepted. The worth ceiling is usually the cost of whatever program and program facility approach is currently in use. That is, you generally do not want to accept an alternative program which is going to cost more than you are presently spending to accomplish the same goals. Any alternative approach which exceeds the worth ceiling is excluded from further consideration. And although the worth ceiling is not generally used in the analysis of non-alternates, it can be and it serves as a way of forcing rigorous planning by requiring that new facilities and the attendant program operational costs fall at or below a given limit, which limit can be relatively arbitrary or based upon the costs of other similar programs elsewhere.

A number of estimates have to be made at this stage and decimal-point accuracy is neither possible nor particularly desirable. You will probably have to estimate the percent of reliable job placement likely (unless

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an existing program can serve as a guide) and you will almost surely have to make an educated guess at the operational cost of each program per year (staffing, materials, utilities, maintenance, etc.). But keep in mind that what we are doing in program value-analysis is emphasizing value, not accurate and precise cost accounting.

From this procedure in Figure 2, you should be able to select the one alternative from among two or more which has the most favorable cost-to-benefit relationship or, in the case of non-alternates, a set of comparative cost figures which can be ranked in a subsequent decision matrix.

Cost, however, is only one of the elements important in deciding which spaces and programs are to be included within a limited building and operating budget and which should be deferred or excluded. The use of a decision matrix forces the definition, weighting, and valuation of explicit criteria. In Figure 3, a decision matrix has been developed to assist in deciding which of several program options is best: a conventional group-instructed welding technology program, a highly individualized, self-paced welding instruction program utilizing the principles of Individually Guided Education (IGE), or a program using a local industrial plant with on-site instructional staff and ancillary instructional facilities (space and some equipment) supplied by the district. Six criteria have been selected as those relevant to deciding which option is most desirable. The specific criteria will, naturally, be somewhat different in each case. A weight is established for each criterion, preferably such that the sum of all the weighting factors equals unity (1.0) and each weighting reflects the decision-maker's valuation of the relative importance which should be accorded each criterion. In the case of Figure 3, it can be seen that "Operational Cost" has been accorded the heaviest single weight (.3) and

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"Community Use" the lightest single weight (.05).

Now we are ready to establish appraisal scores for each option on each of the six decision criteria. Where you are dealing with quantifiable data such as the "Initial Cost" and "Operational Cost" criteria are dependent upon, it is feasible to develop a graphing arrangement such as in Figure 4 which permits you to convert costs (from Figure 2) into normalized appraisal scores. It is advisable to keep all appraisal scores in the 1 - 100 range to reduce the inconvenience of dealing with large numbers. By matching the cost for a given option on one axis of Figure 4, one can determine a normalized appraisal score for that cost along the other axis. Where quantifiable data is not available or applicable (i.e., "Space Flexibility," "Operational Feasibility," or similar criterions), you must arrive at appraisal scores through an informal judgemental process. Again, keep in mind that the purpose in value-analysis programming is to determine relative value of one option as compared to all others. Also, the accuracy of this process, both in determining the weightings for criteria and the appraisal scores, is improved by using a committee of informed individuals and arriving either at consensus figures or averages from individual judgements. The quality of the individuals involved in this process counts for much more than the quantity of persons so involved, but several good minds will more likely produce accurate relative ratings than a single individual.

When all appraisal scores have been entered in the decision matrix (shown in Figure 3 in the upper-left-hand cell of each column), each appraisal score is multiplied by the weight factor for that criterion and the relative value score can then be entered in the lower-right-hand cell of each column for each option. Sum these relative value scores and enter each total in the "Relative Value" column at the far right. In the Figure 3

ple, the option "Welding Technology (IGE Approach)" received a relative of 75.8, indicating that it is superior on the criteria chosen to either ventional group-instruction approach or an on-site program even though received the lowest rating of the 3 options on "Initial Cost."

Figure 5 illustrates another use for this decision-matrix approach. Every vocational-technical building program faces budget constraints which require compromises to varying degrees in the programs and facilities to be provided. In Figure 5 we see compared not alternative instructional methodologies and their attendant space requirements but different program spaces competing for inclusion within a new building or buildings. Here we have the matrix used to develop relative value scores on disparate technical programs. These scores can be rank-ordered from most valued to least valued and, when combined with good building cost data on discrete component cost of each program space, can aid you as the educational planner in identifying where the deletions must be made (see Figure 6). Programs receiving low relative-value scores would appear as good targets for square footage reductions (where they can be made without harming a minimal acceptable performance standard in those programs), possible combining of certain spaces for shared use, or outright deletion of the programs from the facility being planned.

These planning techniques are tools for making better decisions and, as with all tools, they should be used honestly. If they are used to justify prior decisions, it will not be the first time that data were "cooked." But when these methodologies are seen and used as ways of improving the quality of our planning decisions, they can provide us with data which may not have been available to us before. The great value in

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value analysis is that these techniques force us to identify the bases upon which we will reach decisions. Value-analysis planning makes it more difficult for us to give undue weight to some factors and ignore or slight others. Not the least importance of value analysis is that it provides documentation to substantiate major planning decisions. In an era when dollars are fast becoming one of our scarcest resources, we can ill afford the cost of poor decisions.

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FIGURE 1

VALUE-ANALYSIS COST SCHEDULE

1	2	3	4	5	6	7	8	9	10	11	12
CODE	UNIT NET AREA 53,038 SQ. FT. GROSS AREA 74,253 SQ. FT.	NUMBER OF UNITS	SQUARE FOOTAGE	UNITS OF USE	OUTPUT UNITS	BASE COST (EST.)	ANCILLARY SPACE COST (EST.)	ADDED COST (EST.)	TOTAL COST (EST.)	COST/UNIT OF USE	COST/OUTPUT UNIT
01	CHILD CARE OCCUPATIONS										
	(a) CHILD CARE LAB AND NURSERY	1	1,800	24	48	$ 45,000	$ 14,400	$ 26,000	$ 85,400	$ 3,558	$ 1,779
	(b) STORAGE	1	200	-	-	4,800	1,840	650	7,290	-	-
	(c) OFFICE	1	96	-	-	2,496	897	643	4,036	-	-
	(d) TOILET ROOM	1	64	-	-	1,536	598	1,152	3,286	-	-
			2,160	24	48	$ 53,832	$ 17,735	$ 28,445	$100,012	$ 4,167	$ 2,084
02	COSMETOLOGY OCCUPATIONS										
	(a) COSMETOLOGY LAB	1	1,500	20	40	$ 36,000	$ 14,268	$ 38,975	$ 89,243	$ 4,462	$ 2,231
	(b) DISPENSARY	1	200	-	-	4,812	1,820	8,970	15,602	-	-
	(c) STORAGE	1	200	-	-	4,360	1,800	1,650	7,810	-	-
03	AUTOMOTIVE OCCUPATIONS										
	(a) AUTO BODY REPAIR LAB	1	4,400	24	72	$104,940	$ 38,104	$ 83,700	$226,744	$ 9,448	$ 3,149
	(b) AUTOMOTIVE MECHANICS LAB	1	5,200	24	48	131,976	45,240	127,500	304,716	12,697	6,348
	(c) DIESEL ENGINE LAB	1	1,800	20	40	43,200	15,876	47,890	106,966	5,348	2,674
	(d) STORAGE	-	400	-	-	8,272	3,472	8,845	20,589	-	-
	(e) LOCKER-SHOWER ROOMS	2	800	-	-	21,400	7,040	18,920	47,360	-	-
			12,600	68	160	$309,788	$109,732	$286,855	$706,375	$10,388	$14,415
	GRAND TOTALS		58,225			$2,137,000	$256,000	$838,000	$3,231,000		

FIGURE 2

COST/ACHIEVEMENT RELATIONSHIP OF VARIOUS ALTERNATIVES

	a	b	c	
ALTERNATIVES	% OF RELIABLE JOB PLACEMENT	CAPITAL COST	OPERATIONAL COST (PER YEAR)	COST PER % OF RELIABLE JOB PLACEMENT (b+c÷a)*
1	90	$240,000	$48,500	$3,205
2	85	$187,000	$37,600	$2,642
3	60	$142,000	$41,000	$3,050
.				
.				
.				
7	80	$197,000	$53,000	$3,125

*FOR NON-ALTERNATIVE PROGRAMS, USE COST PER JOB PLACEMENT (OUTPUT UNITS x a)

FIGURE 3

DECISION MATRIX FOR THREE ALTERNATIVES

	BENEFITS / WEIGHTINGS / OPTIONS	INITIAL COST	OPERATIONAL COST	STAFF UTILIZATION EFFICIENCY	SPACE FLEXIBILITY	OPERATIONAL FEASIBILITY	COMMUNITY USE	RELATIVE VALUE
	WEIGHTINGS	.2	.3	.15	.1	.2	.05	
O_1	WELDING TECHNOLOGY (CONVENTIONAL GROUP INSTRUCTION)	74 / 14.8	67 / 20.1	75 / 11.25	50 / 5.0	95 / 19.0	100 / 5.0	75.15
O_2	WELDING TECHNOLOGY (IGE APPROACH)	69 / 13.8	60 / 18.0	100 / 15.0	80 / 8.0	80 / 16.0	100 / 5.0	75.8
O_3	WELDING TECHNOLOGY (*IN SITU* PROGRAM)	90 / 18.0	50 / 15.0	60 / 9.0	90 / 9.0	70 / 14.0	40 / 2.0	67.0

FIGURE 4

ESTABLISHED RELATIONSHIP BETWEEN COST AND APPRAISAL SCORE
(NORMALIZATION PROCEDURE)

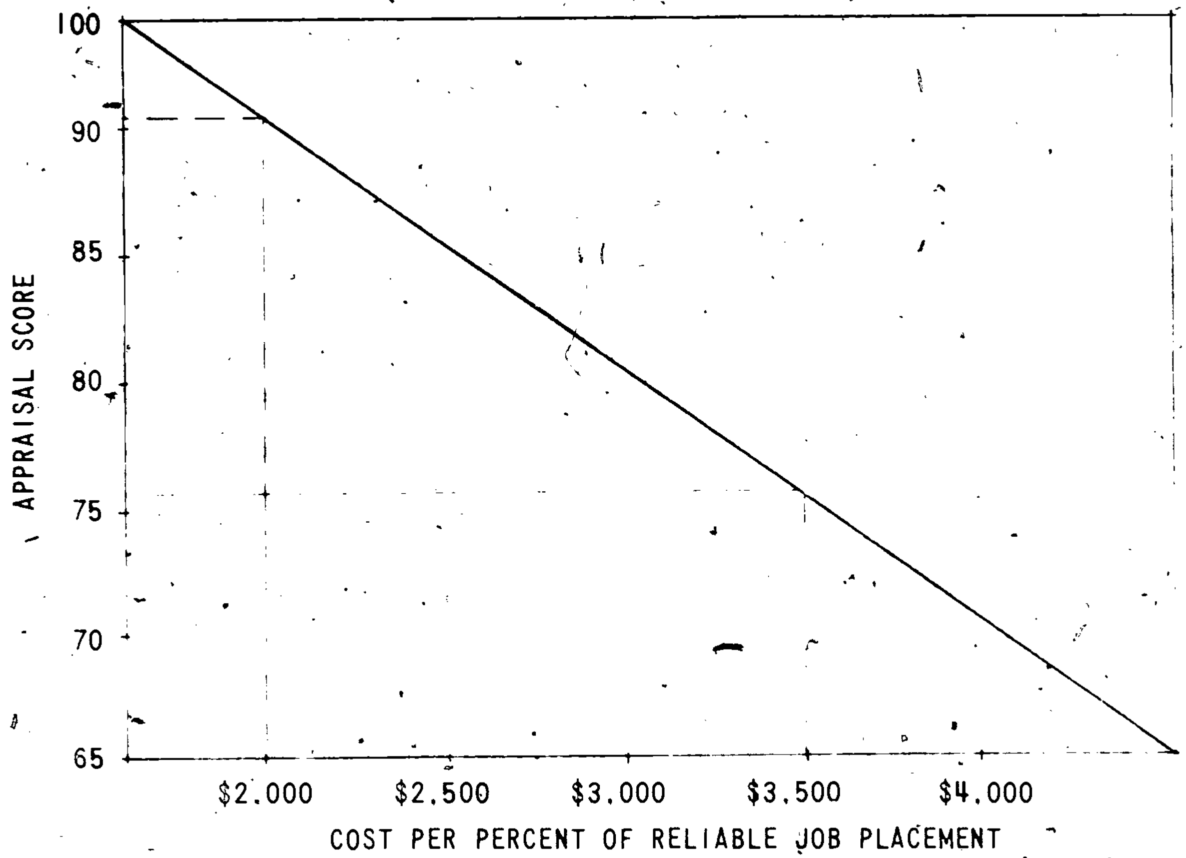

FIGURE 5

DECISION MATRIX FOR FOUR VOCATIONAL/TECHNICAL PROGRAMS COMPETING FOR SPACE IN NEW CONSTRUCTION

BENEFITS / WEIGHTINGS / PROGRAMS	INITIAL COST	COST PER JOB PLACEMENT	STAFF UTILIZATION EFFICIENCY	SPACE FLEXIBILITY	OCCUPATIONAL DEMAND	RELATIVE VALUE
WEIGHTINGS	.3	.15	.05	.1	.4	
CHILD CARE OCCUPATIONS	95 / 28.5	90 / 13.5	70 / 3.5	92 / 9.2	80 / 32.0	86.7
COSMETOLOGY OCCUPATIONS	81 / 24.3	84 / 12.6	90 / 4.5	85 / 8.5	89 / 35.6	85.5
AUTOMOTIVE OCCUPATIONS	85 / 25.5	55 / 8.25	88 / 4.4	50 / 5.0	92 / 36.8	79.95
WELDING TECHNOLOGY OCCUPATIONS	78 / 23.4	60 / 9.0	85 / 4.25	50 / 5.0	94 / 37.6	79.25

FIGURE 6

HIGH- TO LOW- RELATIVE-VALUE OPTIONS WITH COSTS

OPTIONS	RELATIVE VALUE	RANK	COST	ASSUME $1,500,000 SPENDING LIMIT
1	89.5	1	$ 79,000	
2	85.7	2	195,000	
3	81.0	3	297,000	
4	77.9	4	215,000	TOTALS $1,467,000
5	74.2	5	389,000	
6	72.6	6	54,000	
7	71.8	7	238,000	
8	70.6	8	164,000	POSSIBLE CANDIDATES FOR EXCLUSION
9	70.2	9	280,000	
10	70.0	10	196,000	